

Risk assessment – The first step in designing an asset care system



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Risk – proactive or reactive?

The definition of risk is: *the possibility of suffering harm, loss, or danger*. An insurance policy protects against the loss of assets. In the past, this may have been an acceptable approach to dealing with risk. Today, however, no one can insure a plant to the level required to recover all costs associated with loss of life, damage to expensive machinery, and lost production.

Insurance is a reactive approach; it protects after a loss. What is needed is a proactive program to reduce and manage risk. Bently Nevada products and services designed as a system will protect all your machinery assets and provide Actionable InformationSM to help reduce and manage the risk associated with machines.

Designing a risk reduction and management system

The first step in designing a risk reduction and management system is to determine the level of risk associated with each machine. This level of risk or machine “criticality” helps define the type of protection and management system that will provide adequate risk management at the lowest life-cycle cost. Determining the levels is an activity best done jointly by Bently Nevada machinery management engineers and your key plant operations, engineering, and maintenance people.

If the plant to be evaluated is a new construction project, we will use our experience with similar machinery and plants to evaluate risk. We’ll seek input from the plant design engineers, and future end-users regarding their experiences. For both new construction and existing facilities, there are many different criteria that can be used. In general, we will look at

factors that affect production and factors that affect cost. We will weigh these factors, based on our previous experience with similar applications and your direct operations and maintenance experience.

We will derive a composite risk level for each machine. We will then provide a plan for risk reduction and management for either the high risk machines or for all machines, depending on your preference. Part of this plan includes a budgetary cost-benefit analysis if the information is available.

The final product of the assessment is a report documenting the work, summarizing the assessment, and a plan to reduce risk and manage your machinery. You can either use this plan to “open bid” the design of an asset care system, design the system yourself, or ask Bently Nevada to design the system for you.

Assessment criteria

A variety of criteria can be used to assess risk. In general, there are two categories of risk: (1) production loss and (2) cost associated with the machine. The amount of product produced depends on the availability of the machine, the machine rate or performance, and the quality of the product:

$$\text{Actual Product Output} = \text{Product Output Needed} \times \text{Availability} \times \text{Rate} \times \text{Quality}$$

For example, if the machine is capable of producing 1000 units of product and availability is 100%, the rate is 100% of design, and the quality of product produced is 100%:

$$\text{Actual Product Output} = 1000 \times 1 \times 1 \times 1 = 1000 \text{ units}$$

However, if availability is 90%, the rate is only 90% of design, and only 80% of the output meets specification, then:

$$\begin{aligned} \text{Actual Product Output} &= 1000 \times 0.9 \times 0.9 \times 0.8 \\ &= 648 \text{ units} \end{aligned}$$



On-site inspection of equipment enhances survey information.

In our analysis, availability, rate, and quality are based on general machine design characteristics and your facility's direct operating and maintenance experience. Some of the general factors that affect any machine's availability risks are the amount of energy stored in the machine, operating speed, acceleration, general reliability, number of spares, cycling, service, location, maintainability, and the number of machine failures. Production rate risk involves evaluating the effect of the machine on throughput, potential loss of production, and machine output.

Product quality can be affected by individual machines and startup effects. We assess the costs to operate, maintain, and replace the machine. We also look at the costs of environmental impact, safety, and thermal performance/efficiency as they relate to energy consumption costs.

We use "multipliers" to weight the overall level. Two standard multipliers are based on the current level of protection and management systems used on the machines. Other commonly-used multipliers evaluate the effect of your current level of operations and maintenance, the effect of the market on your product, and the level of supporting technologies (oil analysis, thermography, etc.) you use.

Each customer and plant is unique, and we will work with

you to "tune" our assessment criteria to most closely match your business concerns.

Determining and designating levels of risk

The methodology used by Bently Nevada Systems Engineering & Services (BNSSES) is based on sound engineering practices. While we take some advantage of the similar behavior of identical or similar machines, machine classes or other general criteria will not determine risk. In our assessment methodology, we consider each machine individually.

When operating experience is available, statistics are not used to evaluate the risk associated with individual machines. When there is no direct operating experience available, we will use information from machinery manufacturers, but we will rely most heavily on Bently Nevada's thousands of diagnostic case histories. When new machines are analyzed, we will work with Bently Rotor Dynamics Research Corporation to evaluate potential problems.

The evaluation of risk is a qualitative assessment and is not based on a detailed diagnosis of the machine's current health. While on-site, our engineers will inspect your machines and examine your operating and maintenance records. They may take some overall health data using a portable data collector. However, this doesn't take the place of a full diagnostic survey.

While on-site, if the BNSSES engineer notes machinery problems that appear to be serious, we will recommend that a BNSSES machinery diagnostics engineer be consulted. At the end of the risk assessment, BNSSES will also recommend that you consult a diagnostics engineer to examine the current health of all machines noted as being high-risk. We can, of course, include this service in the initial quote for the risk evaluation and have the diagnostics engineer on-site before the end of the risk survey.

Risk levels

Risk levels can be designated in many ways. Some companies use levels 0 through 5, others 1 to 3 or A through E. The designation system isn't important; the assessment is. Bently Nevada has historically defined machine criticality in three categories: Critical, Essential, and Balance-of-Plant.

Three categories of machinery

Critical Machinery – machinery that represents such large business risks including economic, safety, government compliance, or production interruption (often total stoppage of

the process) that mechanical failures cannot be tolerated. This machinery should be both protected and managed.

Essential Machinery – machinery that can cause partial production interruption or some other form of business loss (such as an emissions violation) if it fails, does not run, or runs at reduced capacity. This category of machinery should be both protected and managed, and the protection strategy employed should be consistent with the production interruption or other economic risks the machinery represents.

Balance-of-Plant Machinery – all machinery in a plant that is considered neither critical nor essential. Many of these machines have tandem or spared installations (redundant installations). This machinery should be managed but not protected. Justifications for management of this class of machinery generally relate to maintenance cost savings.

While these three categories may be very useful when looking at a single machine application, they may be too simplistic when assessing an entire plant. There are applications where a machine that is more at risk by its design is in an application that is low risk to the plant. Conversely, there are times when a simple, relatively reliable balance-of-plant type machine is in a service that is critical to plant operations.

The risk of machines is subject to change due to changes in plant process, changes in other assets, and changes in the market. A risk assessment system must include factors to evaluate changes. A machine that is balance-of-plant today may be critical tomorrow.

Bently Nevada hasn't always used the same terminology as that used by customers. That has led to confusion in certain applications.

For plantwide machinery risk evaluations, BNSES will use the level designations you already use, based on your standards, your computerized maintenance management system (CMMS), enterprise resource planning (ERP), or any other information system. If you don't have a preference, we will use a four-level system to define relative risk. You can assign any terminology you want to the levels.



Bently Nevada Service Engineer reviews the risk assessment with key plant personnel.

Reducing and managing risk

Determining and designating risk levels is a process. Reducing and managing risk is the payoff. Once you and BNSES determine the criticality of your machines, we can apply Bently Nevada products and services to reduce risk and provide a way for you to manage it.

We will provide a general plan for each high-risk machine or all machines, based on your preference and budget. We will include our estimate of the risk level after machinery protection and management systems are installed. We can also provide a budgetary cost-benefit analysis, assuming you can provide operating, maintenance, replacement, and potential business interruption costs.

You can then use this plan to budget for the future, develop a more detailed asset care plan, or go directly into engineering design and plan implementation. Of course, you can choose to proceed on your own or contract any qualified engineering services company. However, we hope that you choose BNSES and get the benefit of our 45 years of experience with protection and management systems. To learn more about this valuable risk assessment service, contact any Bently Nevada sales or service professional. [↪](#)